

## 19.

# Eastern Pacific Expeditions of the New York Zoological Society. XXXII. Mollusks from the West Coast of Mexico and Central America. Part. II.\*

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## PLATE I.

[This is the thirty-second of a series of papers dealing with the collections of the Eastern Pacific Expeditions of the New York Zoological Society made under the direction of William Beebe. The present paper is concerned with specimens taken on the Templeton Crocker Expedition (1936) and the Eastern Pacific *Zaca* Expedition (1937-1938). For data on localities, dates, dredges, etc., refer to *Zoologica*, Vol. XXII, No. 2, pp. 33-46, and Vol. XXIII, No. 14, pp. 287-298.]

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## INTRODUCTION.

In Part I of this series of papers<sup>1</sup> the authors outlined a plan for a complete catalogue of the tropical west American mollusks. Since the publication of that plan, conditions resulting from unsettled international political relations have made it necessary to change and drastically reduce the entire plan. Under the existing conditions it is thought better to record now the mollusks collected on the *Zaca* Expeditions, rather than to wait indefinitely for the publication of monographic reports on the fauna as a whole.

In the revised plan of publication only the species secured by the *Zaca* Expeditions of 1936 and 1937-1938 will receive formal headings. These will be followed by a reference to the original description and where desirable an additional reference to an illustration or to an important discussion of the species. The type locality, range, collecting stations, a brief description or de-

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scriptive notes, and the distribution will be given. Some of the species heretofore unillustrated will be figured as will the new species. Keys will include only the species collected on the Zaca Expeditions.

It is hoped that papers of monographic scope dealing with families of tropical west American mollusks may be published from time to time in this or in other scientific periodicals. In that way it may be possible to continue, in a modified form, the original plan of a complete catalogue of the molluscan fauna of this interesting region. The results of studies of several of the families are now in manuscript awaiting publication.

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## CLASS PELECYPODA.

### Order Prionodesmacea.

#### Superfamily Arcacea.

#### Family Glycymeridae.

#### GENUS *Glycymeris* DA COSTA

#### KEY TO THE SPECIES OF *Glycymeris*.

- A. Shell large, smooth or with fine radial striations
  - a. Color pattern of reddish-brown zigzag areas ..... *gigantea*
  - aa. Color pattern of brown dots on umbos ..... *maculata*
- B. Shell with well developed radial ribs
  - a. Ribs few, heavy, not over 12, strongly striated, with wide interspaces
    - b. Ribs rounded, not over 7 ..... *inaequalis*
    - bb. Ribs square, 9 to 11 ..... *delessertii*
  - aa. Ribs 24 to 40, not striated
    - c. Ribs 35-40 ..... *multicostata*
    - cc. Ribs fewer, not over 30
      - d. Altitude usually not over 30 mm.

- e. Hinge evenly rounded ..... *ressellata*
- ee. Hinge angulated ..... *strigilata*
- dd. Altitude over 30 mm., ribs broader ..... *cano*

#### Subgenus *Glycymeris* s.s.

#### *Glycymeris (Glycymeris) gigantea* Reeve.

*Pectunculus giganteus* Reeve, Conch. Icon., Vol. 1, *Pectunculus*, February, 1843, species 3, pl. 1, figs. 3a, 3b. "Hab. Guaymas, Gulf of California. (Found in sandy mud at seven fathoms depth.)"

*Type Locality:* Guaymas, Mexico, in 7 fathoms, sandy mud.

*Range:* Magdalena Bay, Lower California, and from Punta Penasco, to Cape San Lucas, Lower California; Acapulco, Mexico.

*Collecting Stations:* Mexico: Santa Inez Bay, Gulf of California (145-D-1-3), 4 fathoms, sand. Also on beach and at Monument station; Cerralbo Island; Arena Point area, Gulf of California.

*Description:* Shell large, orbicular, thick, finely radially striate, ornamented by waved reddish-brown spots which touch each other and often form a zigzag pattern toward the umbos. There are about 29 or 30 hinge teeth, the central ones smaller than the distal ones. Specimens attaining a height of 100 mm. have been collected at Magdalena Bay, Lower California.

The zigzag reddish-brown color pattern serves to separate this species from *G. maculata* Broderip whose coloration consists of brown spots. The color pattern also serves to easily separate it from the Mediterranean species *G. bimaculata* Poli.

*Distribution:* The distribution of *Glycymeris gigantea* seems to be very limited. It occurs at Magdalena Bay, Lower California, and is known to occur from Pliocene to Recent in the Gulf of California region. It has been recorded from Acapulco, but it does not appear to be common south of the Gulf of California.

#### *Glycymeris (Glycymeris) maculata* Broderip.

*Pectunculus maculatus* Broderip, Proc. Zool. Soc. London, August 14, 1832, p. 126. "Hab. in Portu Potrero". "Found in fine gravel in eleven fathoms of water."—Reeve, Conch. Icon., Vol. 1, *Pectunculus*, 1843, species 4, pl. 1, fig. 4. "Hab. Puerto Potrero, Central America. Cuming."

*Type Locality:* Puerto Potrero, Costa Rica, in 11 fathoms, fine gravel.

*Range:* Magdalena Bay, Lower California, and Punta Penasco, Sonora, Mexico, to Zorritos, Peru.

*Collecting Stations:* Mexico: Arena Bank, Gulf of California (136-D-30), 35 fathoms, sand, weed; Cerralbo Channel (137-D-3), 46



fathoms, rock; Port Guatulco (195-D-9, 17), 6-7 fathoms, gravel, sand, crushed shell; Tangola-Tangola Bay (196-D-6, 7), 6-7 fathoms, sand, crushed shell; Nicaragua: Gulf of Fonseca, Potosi and Monypenny Point; Corinto (200-D-19), 12-13 fathoms, mangrove leaves; Costa Rica: Piedra Blanca Bay (208-D-1, 10), 2-6 fathoms, rocks, sand, algae.

**Description:** The shell of *Glycymeris maculata* is large, orbicular, and ornamented by small chestnut brown spots which occur on the earlier part of the shell. This color pattern serves to separate it from *C. gigantea* Reeve. Radial striae are present on the exterior of the shell.

**Distribution:** This species occurs in shallow water from the northern part of the Gulf of California to Peru.

#### Subgenus *Tuceta* Bolten.

*Tuceta* Bolten, Mus. Boltenianum, 1798, p. 172.

**Type** (here designated): "*T. pectunculus*." [In the synonymy of which Bolten included *Arca pectunculus* Gmelin, illustrated by Chemnitz, Conchyl.-Cab., Bd. 7, 1784, Tab. 58, figs. 568 and 569. Red Sea].

*Tuceta* Bolten has by some authors been placed in the synonymy of *Glycymeris* s.s. So far as we know no type has been designated heretofore for *Tuceta* and we therefore designate *Tuceta pectunculus*, in the synonymy of which Bolten placed *Arca pectunculus* Gmelin [= *Arca pectunculus* Linnaeus] illustrated by Chemnitz. This is a strongly ribbed form with an arcuate hinge. *Tuceta* thus becomes available for strongly ribbed species of *Glycymeris* similar to the type species.

#### *Glycymeris (Tuceta) multicostata* Sowerby.

*Pectunculus multicostatus* Sowerby, Proc. Zool. Soc. London, 1832 (issued March 13, 1833), p. 195. "Hab. in America Meridionali." "Found in coarse sand and gravel, in twelve fathoms water, off the Island of Muerte, in the Bay of Guayaquil."—Reeve, Conch. Icon., Vol. 1, *Pectunculus*, 1843, species 26, pl. 5, fig. 26. "Hab. Bay of Guayaquil (found in coarse sand and gravel at the depth of twelve fathoms); Cuming."

**Type Locality:** Off the Island of Muerte, Bay of Guayaquil, Ecuador, in 12 fathoms, coarse sand and gravel.

**Range:** Punta Penasco, Sonora, Mexico, to Guayaquil, Ecuador.

**Collecting Stations:** Mexico: Santa Inez Bay, Gulf of California (143-D-1; 144-D-2, also on beach), 2½-29 fathoms, mud, crushed shell, rock, weed. Cerralbo Island, Gulf of California; Arena Bank, Gulf of California (136-D-18, 27), 40-50 fathoms, mud, sand, calcareous algae, rock; Port Guatulco; Panama: Bahia Honda; Colombia: Gorgona Island.

**Description:** The shell of *Glycymeris multicostata* is elongately rounded in outline and is usually ornamented with about 35 to 40 well developed flat topped radiating ribs. The ribs vary in number and in width and in some cases are ornamented by longitudinal incised lines toward the anterior ventral margin. The ribs increase in number both by bifurcation and intercalation. On the beaks the ribbing often occurs in fascicules. The general color of the shell is gray variegated with chestnut. There is usually some brownish color in the interior of the shell, especially the posterior part.

The species described as *Pectunculus septentrionalis* by Middendorff appears to be a synonym of *Glycymeris multicostata*. Although *Glycymeris septentrionalis* has been cited in the literature as occurring in Alaska, we have seen no specimens from that region which could be referred to the species as characterized by Middendorff's original description and illustrations. Middendorff compared his species to *Glycymeris multicostata* and to the figure referred to *G. inaequalis* by Sowerby in Beechey's voyage which really represents *G. bicolor*, a form very close to *G. multicostata*. The shape, hinge, character of ribbing and color pattern in Middendorff's figures all conform with those of *G. multicostata*. The ribbing occurring in fascicules on the beaks is very characteristic of *G. multicostata*. The type specimen of Middendorff's species was said to have been collected by Wosnessensky at Ukamok Island (also known as Chirikof Island), near Kodiak, Alaska. Wosnessensky also collected in the Gulf of California, a region where *G. multicostata* occurs commonly. It appears then, unfortunately, that *Pectunculus septentrionalis* must be relegated to the synonymy of *Glycymeris multicostata*.

**Distribution:** This species occurs at many localities from the Gulf of California to Peru and is known to occur from Pliocene to Recent.

#### *Glycymeris (Tuceta) tessellata* Sowerby.

*Pectunculus tessellatus* Sowerby, Proc. Zool. Soc. London, 1832 (issued March 13, 1833), p. 196. "Hab. ad littora Columbiae Occidentalis." "From sandy mud and gravel, in from eight to ten fathoms, at Monte Christie and in the Bay of Xipixapi."—Reeve, Conch. Icon., Vol. 1, *Pectunculus*, 1843, species 29, pl. 6, fig. 29. Original locality record cited.

**Type Locality:** Monte Cristi, Ecuador, in 8 to 10 fathoms, sandy mud and gravel, here designated as type locality. Bay of Xipixapi, Ecuador, also cited originally.

**Range:** Arena Bank, northeast of Cape San Lucas, Lower California, to Xipixapi, Ecuador.

**Collecting Stations:** Mexico: Arena Bank,



Gulf of California (136-D-6, 13, 15, 18, 22, 24), 40-50 fathoms, mud, *Arca* conglomerate, sand, weed, crushed shell, muddy sand; Gorda Banks, Gulf of California (150-D-8), 40-45 fathoms, muddy sand; Manzanillo (184-D-2), 30 fathoms, gravelly sand; Port Guatulco (195-D-9), 7 fathoms, gray sand, crushed shell; Santa Cruz Bay; Costa Rica: Port Parker (203-D-1, 2, 3, also on beach), 12-15 fathoms, sandy mud, crushed shell, shelly mud; Port Culebra (206-D-1, 2, 3), 14 fathoms, sandy mud; 14 miles S. E. of Judas Point (214-D-1-4), 42-61 fathoms, mud, shell, rocks; Panama: Bahia Honda (222); Hannibal Bank.

**Description:** The shell of *Glycymeris tessellata* is triangularly orbicular, somewhat attenuated toward the umbos. The ribs, about 25 in number, are rounded and rather wide. The shell is colored by tessellated rich purple spots on a grayish-white background.

The largest specimens in this collection assigned to *Glycymeris tessellata* measure about 33.3 mm. in height. The width of the ribs appears to be somewhat variable. From the descriptions of Sowerby and Reeve there appears to be but little difference between *Glycymeris tessellata* and *strigilata* except that the latter has a more angular hinge and usually smaller ligamentary area. It is on those characters that we have separated the two forms but it is not at all certain that these are constant. Some of the forms here referred to *tessellata* have about 25 ribs, a rounded hinge with about 24 teeth which are strong on the sides but which become very weak in the center of the hinge. In a series of specimens these distinctions appear very much less pronounced and there is a suggestion of gradation from this form to those with more numerous teeth with a rounded angular hinge.

*Glycymeris pectinata* Gmelin from the Caribbean region is a similar species.

**Distribution:** This species occurs fairly commonly from the Gulf of California to Ecuador. It is also known to occur in the Pleistocene.

***Glycymeris (Tuceta) tessellata canoa*  
Pilsbry & Olsson.**

*Glycymeris canoa* Pilsbry & Olsson, *Proc. Acad. Nat. Sci. Philadelphia*, Vol. 93, September 9, 1941, p. 54, pl. 13, figs. 2, 2a. "Canoa formation, Punta Blanca", Ecuador, Pliocene.

**Type Locality:** Canoa formation, Punta Blanca, Ecuador, Pliocene.

**Range:** Known living only from Arena Bank, Gulf of California.

**Collecting Station:** Mexico: Arena Bank, Gulf of California (136-D-5, 22), 33-45 fathoms, sand, weed, mud.

**Description:** This form differs from typi-

cal *tessellata* in the much greater size, extremely broad ribs and in that the color markings are more in the nature of concentric zigzag lines rather than in large spots. There are about 24 teeth on the hinge but on some large specimens there are only about 20, and the center of the hinge is nearly smooth. A typical specimen measures: height, 48.5 mm., length, 46 mm., convexity (both valves), 28.5 mm.

This subspecies appears to be a giant form of *Glycymeris tessellata* Sowerby but differs in the much greater size and broader and flatter ribs. Judging from the original description and illustrations of *Glycymeris canoa*, the specimens from the Gulf of California appear to be identical with those from the Pliocene of Ecuador.

**Distribution:** This subspecies is known living at the present time only at Arena Bank, in the southern end of the Gulf of California. It occurs in the Pliocene of Ecuador and it seems likely that it may be found living at other localities between the Gulf of California and Ecuador.

***Glycymeris (Tuceta) tessellata strigilata*  
Sowerby.**

*Pectunculus strigilatus* Sowerby, *Proc. Zool. Soc. London*, 1832 (issued March 13, 1833), p. 196. "Hab. ad Sanctam Elenam." "Dredged from a depth of six to eight fathoms in sandy mud."—Reeve, *Conch. Icon.*, Vol. 1, *Pectunculus*, 1843, species 31, plate 6, fig. 31. Original locality record cited.

**Type Locality:** Santa Elena, Ecuador, in 6 to 8 fathoms, sandy mud.

**Range:** Manzanillo, Mexico, to Santa Elena, Ecuador.

**Collecting Stations:** Mexico: Manzanillo (184-D-1-2), 25-30 fathoms, sand and gravelly sand; Costa Rica: Port Parker (203-D-1, 3), 12-15 fathoms, sandy mud, crushed shell, shelly mud.

**Description:** There appears to be little to separate the form described by Sowerby under the name "*Pectunculus strigilatus*" from that described as *P. tessellatus*. The only character cited for the form *Glycymeris t. strigilata* which may separate it from *G. tessellata* is that given by Reeve who stated "A very solid broadly ribbed shell, so peculiarly contracted towards the umbones that the hinge almost describes an angle."

In the present collection, a series of specimens dredged off Manzanillo, Mexico, seems to answer that description. The largest specimen measures 28.5 mm. from beak to base. There are about 24 to 25 ribs which in some shells are rounded but in others flattened. There are about 30 rather fine teeth which near the center of the hinge become shorter and weaker. It is uncertain whether this will prove to be a constant



character because there appears to be a gradation to forms with a rounded hinge with stronger and fewer hinge teeth. The triangular ligamentary area is generally smaller than that on typical *Glycymeris tessellata*.

The same sort of angularity of the hinge of the form *G. t. strigilata* is sometimes noticed on specimens of *G. pectinata* Gmelin.

**Distribution:** This subspecies occurs from off western Mexico to Ecuador along with *Glycymeris tessellata*.

#### Subgenus *Axinactis* Mörch.

*Axinactis* Mörch, Malakozool. Blätter, Bd. 7, 1861, p. 203. Species in original list: "*Axinaea* (*Axinactis*) *inaequalis* Sow." and "*Axinaea* (*Axinactis*) *assimilis* Sow.?"

**Type** (here designated): *Axinaea* (*Axinactis*) *inaequalis* Sowerby.

Shell roundly triangular, thick, beaks opisthogyrate; ribs wide and separated by narrower interspaces; ribs, interspaces and margins covered by fine radial ribs which are separated by fine incised lines; cardinal area forming an elongate asymmetric triangle and ornamented by six or seven incised lines which run diagonally to the base from an impressed line bordering the posterior part of the area; only a small portion of the ligament occurs in front of the beaks; hinge with two series of chevron-shaped teeth, the two series separated by an impressed line which is almost directly in line with the beaks; the posterior portion of the anterior series small and nearly vertical; on perfectly preserved specimens a fine row of denticles is present along the rather straight portion of the posterior margin; inner margin of valves fluted.

#### *Glycymeris* (*Axinactis*) *delessertii* Reeve.

*Pectunculus delessertii* Reeve, Conch. Icon., Vol 1, *Pectunculus*, December, 1843, species 52, pl. 9, fig. 52. "Hab.—?"

*Glycymeris delessertii* Reeve, Pilsbry & Lowe, *Nautilus*, Vol. 47, No. 3, 1934, p. 85. Maria Madre Island, Tres Marias Islands, Mexico.

**Type Locality:** No locality originally cited. Maria Madre Island, Tres Marias Islands, Mexico, here designated as type locality.

**Range:** Mazatlan, Mexico, to Panama.

**Collecting Station:** Mexico: Port Guatulco, on beach.

**Description:** A worn left valve of *Glycymeris delessertii* is present in the collection from Port Guatulco, Mexico. The shell of this species is ornamented by about 9 to 11 squarish ribs which are separated by interspaces a little narrower. The ribs are ornamented by riblets separated by longitudinally incised lines varying in depth and number. These incised lines continue over

the interspaces on the anterior and posterior portions of the shell but in the median portion the interspaces are only finely striated.

The more numerous, narrower, square ribs easily separate this species from *Glycymeris inaequalis* Sowerby.

**Distribution:** This species has been collected at Mazatlan, the Tres Marias Islands, Port Guatulco, Mexico, and at Panama. It is also known to occur in the Pleistocene of Oaxaca, Mexico.

#### *Glycymeris* (*Axinactis*) *inaequalis* Sowerby.

*Pectunculus inaequalis* Sowerby, *Proc. Zool. Soc. London*, 1832 (issued March 13, 1833), p. 196. "Hab. ad Panamam et Real Llejos." "Found in sandy mud in ten fathoms."—Reeve, *Conch. Icon.*, Vol. 1, *Pectunculus*, 1843, species 16, pl. 4, fig. 16. Original locality record cited.

**Type Locality:** Panama City, Panama, in 10 fathoms, sandy mud, here designated as type locality. Real Llejos [near Corinto], Nicaragua, also cited originally.

**Range:** San Marcos Island, Gulf of California, to Bayover, Peru.

**Collecting Stations:** Nicaragua: Corinto (200-D-19), 12-13 fathoms, mangrove leaves; Costa Rica: Piedra Blanca Bay (208-D-1, 10), 2-6 fathoms, rocks, sand, algae.

**Description:** This species is readily recognized by the presence of about 6 rather broad, rounded ribs which on the anterior and posterior portions of the shell give way to one or two small ribs. The ribs are wider than the interspaces and both are covered by small somewhat irregular riblets which are due to the presence of incised lines. The color of the exterior of the shell is a whitish background with irregular concentric bands of dark brown color.

*Glycymeris inaequalis* can be separated from *G. delessertii* by the presence of the fewer, broader, rounded ribs. The species described as *Pectunculus assimilis* by Sowerby can be relegated to the synonymy of *Glycymeris inaequalis*.

**Distribution:** This species has been recorded from various localities from the Gulf of California to Peru. It is also known to occur in the Quaternary of Ecuador.

#### Family Arcidae.\*

##### KEY TO THE GENERA AND SUBGENERA OF THE ARCIDAE.

##### A. Beaks curved toward the anterior... *Arca* a. Inner margin of valves smooth

\*For a classification of the Arcidae, see Reinhart, P. W., "Classification of the Pelecypod Family Arcidae," *Bull. Mus. Roy. Hist. Nat. Belgique*, Tome 11, No. 13, 1935, 68 pp., pls. 1-5.

Another important paper published recently by Reinhart is entitled "Mesozoic and Cenozoic Arcidae from the Pacific Slope of North America," *Geol. Soc. America, Special Papers* No. 47, June 16, 1943, pp. XI, 1-117, pls. 1-15, 3 figs. in text, 3 tables.



- b. Hinge with a continuous series of teeth
- c. Ligamental area extremely wide and almost flat; posterior end more or less expanded. *Arca* s.s.
- cc. Ligamental area narrow, V-shaped
- d. Ligamental area extending equally on each side of the umbos ..... *Barbatia*
- dd. Ligamental area extending mainly posterior to the umbos
- e. Muscle scars prominent, elevated; anterior and posterior ribs not larger than the others ..... *Acar*
- ee. Muscle scars not prominent; large anterior and posterior ribs ..... *Calloarca*
- bb. Hinge with an edentulous pit or gape in the middle ..... *Arcopsis*
- aa. Inner margin of valves crenulated
  - f. Right and left valves equal in size and sculpture
  - g. Ligamental area extending equally on each side of the umbos
  - h. Central teeth perpendicular to the hinge line. *Anadara*
  - hh. Central teeth diverging ..... *Larkinia*
  - gg. Ligamental area extending mainly posterior to the beaks ..... *Lunarca*
  - ff. Left valve the larger, overlapping the right
    - i. Posterior dorsal margin with a flattened auriculation ..... *Cara*
    - ii. Posterior dorsal margin without a flattened auriculation
    - j. Sculpture of the two valves similar or only slightly different ..... *Scapharca*
    - jj. Sculpture of the two valves strongly discrepant ..... *Cunearca*
- B. Beaks curved toward the posterior. *Noetia*
  - a. Shell trigonal ..... *Noetia* s.s.
  - aa. Shell elongate
    - b. Posterior end strongly expanded ..... *Sheldonella*
    - bb. Posterior end not expanded. *Eontia*

GENUS *Arca* LINNAEUS.Subgenus *Arca* s.s.KEY TO THE SPECIES OF *Arca* s.s.

- A. Shell expanded posteriorly; posterior margin notched ..... *pacifica*

- B. Shell not expanded or notched posteriorly but obliquely truncated or rounded ..... *mutabilis*

***Arca (Arca) fernandezensis* Hertlein & Strong, nom. nov.**

*Arca angulata* King & Broderip, *Zool. Jour.*, Vol. 5, July, 1832, p. 336. "Habitat ad Juan Fernandez." "This shell was dredged up from 80 fathoms water in the offing of Cumberland Bay, at Juan Fernandez; it was attached to a branch of coral."—Stempell, *Zool. Jahrb.*, Suppl. Bd. 5, December 20, 1899, Fauna Chilensis, Bd. 2, p. 219, pl. 12, figs. 1-9. Juan Fernandez Island, on rocks along the coast and in 20 to 40 fathoms.

Not *Arca angulata* Meuschen, *Mus. Gev.*, 1787, p. 426.

A study of the west American species of Arcidae revealed that the specific name *angulata* of King and Broderip had been used earlier for a species of *Arca* by Meuschen. The new name *Arca fernandezensis* is here proposed for the species from Juan Fernandez Island.

***Arca (Arca) mutabilis* Sowerby.**

*Byssarca mutabilis* Sowerby, *Proc. Zool. Soc. London*, May 17, 1833, p. 17. "Hab. in Colombia occidentali." "Found under stones at the Isle of Plata".

*Arca mutabilis* Sowerby, *Reeve, Conch. Icon.*, Vol. 2, *Arca*, 1844, species 85, pl. 13, fig. 85. Original locality record cited.

*Type Locality*: Island of La Plata, Ecuador, under stones.

*Range*: Magdalena Bay, Lower California, and the Gulf of California, to Guayaquil, Ecuador.

*Collecting Stations*: Mexico: Arena Bank, Gulf of California (136-D-21), 45 fathoms, mud; Port Guatulco; Sihuatanejo; Costa Rica: Port Parker; Port Culebra; Piedra Blanca; Isla Cedro.

*Description*: The four to six ribs on the posterior slope of the shell of *Arca mutabilis* are somewhat coarser than the others and in fresh shells these are characteristically dark in color. The ligamentary area is concave.

*Arca mutabilis* is strikingly like *A. imbricata* Bruguière of the western Pacific. Lamy considered the two forms to differ only subspecifically. *Arca santamariensis* Reinhart from the Pliocene of California is similar to *A. mutabilis* but is said to differ in ornamentation and in the shape of the ligamental area.

*Distribution*: This species is often found under rocks at low tide from Magdalena Bay, Lower California, and the Gulf of California, to Ecuador.



***Arca (Arca) pacifica* Sowerby.**

*Byssarca pacifica* Sowerby, *Proc. Zool. Soc. London*, May 17, 1833, p. 17. "Hab. ad Sanctam Elenam." "Found on rocky ground, in from six to eighteen fathoms, adhering to each other in large bunches."

*Arca pacifica* Sowerby, Reeve, *Conch. Icon.*, Vol. 2, *Arca*, 1844, species 75, pl. 11, fig. 75. Original locality record cited.

**Type Locality:** Santa Elena, Ecuador, in 6-18 fathoms, on rocky ground.

**Range:** Scammon Lagoon, Lower California, to Paita, Peru, and the Galápagos Islands.

**Collecting Stations:** Mexico: Santa Inez Bay, Gulf of California (145-D-1, 3), 4-13 fathoms, sand; Santa Inez Point, Lower California; Arena Bank, Gulf of California (136-D-1, 17), 45 fathoms, mud and *Arca* conglomerate; Arena Point area, Lower California; Gorda Banks, Gulf of California (150-D-7-8, 16), 20-75 fathoms, sand, muddy sand, rock, calcareous algae; Cape San Lucas, Lower California; Passavera Island, Chamela Bay; Nicaragua: Corinto (200-D-19), 12-13 fathoms, mangrove leaves on bottom; Costa Rica: Port Parker; Piedra Blanca (208-D-1-10), 2-6 fathoms, rocks, algae, sand; Panama: Hannibal Bank; Bahía Honda; Colombia: Gorgona Island.

**Description:** The shell of *Arca pacifica* is expanded and notched posteriorly. It is ornamented by radiating ribs and is colored by narrow, rounded V-shaped brown bands. It is more expanded posteriorly than *A. occidentalis* Philippi, a species living in the Caribbean region.

**Distribution:** This species often occurs from Scammon Lagoon, Lower California, to Peru, under rocks at very low tide and in shallow water. It also occurs in the Pliocene and Pleistocene of Lower California.

**Subgenus *Acar* Gray.*****Arca (Acar) gradata* Broderip & Sowerby.**

*Arca gradata* Broderip & Sowerby, *Zool. Jour.*, Vol. 4, January, 1829, p. 365. "Hab. ad littora Oceani Pacifici." Also "From Mazatlan."

*Barbatia (Acar) gradata* Sowerby, Reinhart, *Trans. San Diego Soc. Nat. Hist.*, Vol. 9, No. 10, 1939, pp. 39-43, pl. 3, figs. 1a, 1b, 5a, 5b, 6a, 6b, 6c, 6d, 6e. Mazatlan, Mexico, and Taboga Island, Panama.

**Type Locality:** Pacific Ocean, littoral. Also Mazatlan. [Mazatlan, Mexico, stated to be the type locality by Reinhart and accepted as such by the present authors].

**Range:** Point Abrejos, Lower California, to Punta Penasco, Sonora, Mexico, and south to Negritos, Peru, and the Galápagos Islands.

**Collecting Stations:** Mexico: Cape San Lucas, Lower California; Sulphur Bay,

Clarion Island; Banderas Bay; Port Guatuleo (195-D-9, 15), 1.5 to 7 fathoms, gray sand, crushed shell, coral; Tangola-Tangola Bay (196-D-14-15, and beach), 5 fathoms, crushed shell; Nicaragua: Corinto (200-D-19), 12-13 fathoms, mangrove leaves on bottom; Costa Rica: Port Parker; Ballena Bay; Uvita Bay.

**Description:** Shell moderately thick for its size, ornamented exteriorly by reticulate sculpture. On some specimens granules are developed at the point where the concentric crosses the radial sculpture. At the time of the original description of the species Broderip & Sowerby stated, "This elaborately ornamented shell looks at first sight like a piece of Chinese carving." Large specimens attain a length of about 30 mm.

The first published figure of *Arca gradata* is in the Zoology of Beechy's Voyage, 1839, p. 152, pl. 43, fig. 1. The part of that work here involved was prepared by Sowerby so the specimen may be considered to be authentic in the absence of information to the contrary. This figure shows a coarsely sculptured shell. This interpretation of the species is identical with that of Reinhart who has discussed and illustrated the holotype.

*Arca gradata* closely resembles *A. reticulata* Gmelin, a Caribbean species, and there are somewhat similar species in the Western Pacific.

**Distribution:** This species occurs from Lower California to Peru and the Galápagos Islands. It is often found under rocks between tides.

**Subgenus *Anadara* Gray.****KEY TO THE SPECIES OF *Anadara*.**

- A. Anterior dorsal margin acutely pointed; about 30 ribs.....*biangulata*
- B. Anterior dorsal margin forming nearly a right angle, or rounded
  - a. Anterior ribs deeply grooved, finely nodulous.....*formosa*
  - aa. Anterior ribs not grooved or only faintly so
  - b. Ribs 35-37
    - c. Ribs tuberculated, shell high.....*tuberculosa*
    - cc. Ribs smooth, shell elongate.....*mazatlanica*
  - bb. Ribs 40-44.....*similis*

***Arca (Anadara) biangulata* Sowerby.****Plate I, Figure 3.**

*Arca biangulata* Sowerby, *Proc. Zool. Soc. London*, May 17, 1833, p. 21. "Hab. ad littora Columbiae Occidentalis. (Atacamas)." "A single specimen was dredged at a depth of seven fathoms."

*Arca gordita* Lowe, *Trans. San Diego*



*Soc. Nat. Hist.*, Vol. 8, No. 6, March 21, 1935, p. 16, pl. 1, fig. 1. "Acapulco, 20 fathoms" (type). Also "Guaymas, 20 fathoms" and "off West Mexico."—R. H. Palmer & Hertlein, *Bull. South. Calif. Acad. Sci.*, Vol. 35, pt. 2, May-August [issued September 10], 1936, p. 70, pl. 19, figs. 1 and 4. Pleistocene of Oaxaca, Mexico.

*Type Locality*: Atacames, Western Ecuador, dredged in 7 fathoms. Of *Arca gordita*, Acapulco, Mexico, in 20 fathoms.

*Range*: Guaymas, Sonora, Mexico, to Paita, Peru, and the Galápagos Islands.

*Collecting Stations*: Mexico: Santa Inez Bay, Gulf of California (143-D-1, 5), 18-29 fathoms, sand, mud, crushed shells, weeds; Gorda Banks, Gulf of California (150-D-8), 40-45 fathoms, muddy sand; Manzanillo Bay (184-D-2), 30 fathoms, gravelly sand; Costa Rica: Port Parker (203-D-1, 3), 12-15 fathoms, sandy mud, shelly mud, and crushed shells; 14 miles southeast of Judas Point (214-D-1 to 4), 42-61 fathoms, mud, shell, rocks; Panama: Gulf of Chiriqui (221-D-1 to 5), 35-40 fathoms, sandy mud.

*Description*: *Arca biangulata* was originally described by Sowerby as oblong, ventricose, white, radiately ribbed, covered by a brown periostracum, dorsal margin anteriorly acute, posteriorly obtusely angulated; anterior end shorter and higher; posteriorly subacuminate; ligamentary area elongate, flat, wider anteriorly. Length, 2.0; width, 1.2; height, 1.3 poll.

That description exactly applies to the shell described by Lowe as *Arca gordita*. The shell is sharply pointed anteriorly and is ornamented by about 30 ribs. Palmer and Hertlein have pointed out the resemblance of this form to Miocene species of the Caribbean region.

*Distribution*: This species is now known to occur from the Gulf of California to Peru. It is also known to occur in the Pleistocene of Oaxaca, Mexico.

#### *Arca (Anadara) formosa* Sowerby.

*Arca formosa* Sowerby, *Proc. Zool. Soc. London*, May 17, 1833, p. 20. "Hab. in America Centrali. (Gulf of Tehuantepec)." —Reeve, *Conch. Icon.*, Vol. 2, *Arca*, 1843, species 10, pl. 2, fig. 10. "Hab. Gulf of Tehuantepec, Mexico (found in sandy mud at the depth of from ten to twelve fathoms); Cuming."

*Type Locality*: Gulf of Tehuantepec, Mexico.

*Range*: Cedros Island, off Lower California, to Paita, Peru.

*Collecting Stations*: Mexico: East of Cedros Island (126-D-6), 45 fathoms, mud; Tangola-Tangola Bay (196-D-6-7), 6-7 fathoms, sand and crushed shell; El Salvador: La Union; Costa Rica: Culebra Bay; Piedra Blanca.

*Description*: Shell elongate, posterior dorsal area rather broad and somewhat concave, ornamented by about 35 to 38 flat-topped ribs. The posterior ribs are wider, the anterior ones finely nodulous and divided by a groove.

Two specimens referable perhaps to this species were dredged about 3 miles east of Cedros Island. A specimen from La Union, Gulf of Fonseca, El Salvador, measures 112.3 mm. in length.

*Distribution*: This species is known to occur from Cedros Island, Lower California, to Peru, but is not very abundant in any of the collections which we have studied.

#### *Arca (Anadara) mazatlanica* Hertlein & Strong, sp. nov.

Plate I, Figures 1 and 4.

Shell elongately-oval, moderately convex, equivalve, white under a brown epidermis which is thin and rubbed near the beaks, thicker toward the margin and fringed in the interspaces between the ribs; hinge line straight with beaks rising above it at about the anterior third; anterior end forming almost a right angle at the end of the hinge line, then slightly rounded; posterior end forming an obtuse angle at the end of the hinge line, roundly pointed at the junction with the basal margin which is slightly convex and without a gape; sculpture of 35 broad, smooth, flat-topped ribs with narrow interspaces; ligamental area fairly broad, with 4 incised lines angulated under the beaks in such a manner as to leave a smooth, flattened shelf along the anterior dorsal margin; hinge with about 60 narrow teeth extending about the full length of the hinge line, small, vertical and closely spaced in the middle, larger, wider spaced and slightly oblique towards the ends. The type measures: longitudinal diameter, 62 mm., vertical diameter, 36.3 mm.; convexity of the two valves, 31 mm.

Holotype, and paratypes (Calif. Acad. Sci. Paleo. Type Coll.), dredged at Station No. 153-D-2, in approximately Lat. 23°06'N., Long. 106°47'W., 19 miles west of Mazatlan, Mexico. Twenty additional specimens were dredged in the same locality. In the same general locality six specimens were dredged at Station 153-D-3. Three odd valves were dredged at Station 155-D-1, in 56 fathoms thirteen miles west of Mazatlan, Gulf of California, Lat. 23°12'N., Long. 106°40'W., in 56 fathoms in mud. One specimen was dredged at 143-D-5, Lat. 26°54'N., Long. 111°53'W., Santa Inez Bay, Lower California, in 18 fathoms in sand.

*Range*: Santa Inez Bay, east coast of Lower California, to off Mazatlan, Mexico.

In many ways this species resembles *Arca formosa* Sowerby but the anterior end is shorter and more sharply angulated at the



hinge line. Also the ribs show no indication of a median groove. The ventral margin of the new species is rounded while that of *Arca formosa* is nearly straight. The new species bears a resemblance to *Arca concinna* but it is a higher shell, the anterior end is more obliquely rounded and the basal margin is more swollen and rounded.

The new species also bears a close resemblance to "*Barbatia (Diluvarca) halidonata oresta*" Woodring<sup>2</sup> but seems to have wider ribs than the east coast fossil. *Arca springvalensis* Vokes<sup>3</sup> from the Miocene of Trinidad is also somewhat similar in its general features.

*Arca secticostata* Reeve is somewhat similar to *A. mazatlanica*. Tomlin cited "*Anadara secticostata*" Reeve<sup>4</sup> from Coiba Island, Panama. That record can probably be referred to *Arca formosa* or to some similar but different West American species.

#### *Arca (Anadara) reinharti* Lowe.

*Arca (Anadara) reinharti* Lowe, *Trans. San Diego Soc. Nat. Hist.*, Vol. 8, No. 6, March 21, 1935, p. 16, pl. 1, figs. 3a, 3b, 3c. "Guaymas, 20 fathoms" (type). P. 27, Punta Penasco, Sonora, Mexico, dredged in 10 fathoms.

*Type Locality*: Guaymas, Mexico, in 20 fathoms.

*Range*: Punta Penasco, Sonora, Mexico, to Bahia Honda, Panama.

*Collecting Stations*: Mexico: Manzanillo (184-D-2), 30 fathoms, gravelly sand; Nicaragua: Corinto (200-D-19), 12-13 fathoms, mangrove leaves on bottom; Costa Rica: Port Parker (203-D-1,-3), 12-15 fathoms, sandy mud, shelly mud, algae; Panama: Gulf of Chiriqui (221-D-1), 35 fathoms, sandy mud; Bahia Honda.

*Description*: The specimens here referred to *Arca reinharti* appear to be identical with a paratype No. 4697a of that species in the collection of the California Academy of Sciences. The present specimens appear to be a little longer than the type of *A. reinharti* as figured by Lowe. The type was described as possessing about 25 ribs. The specimens in the present collection have about 27 ribs which would appear to fall within the variation of the species. Some specimens are much thinner than others and the ribs are smoother but otherwise they appear to be identical with typical *A. reinharti*.

*Arca reinharti* bears a considerable resemblance to young specimens of *A. multi-*

*costata* Sowerby. Both are slightly inequivalve, the left valve over-lapping the right. The shells of *A. reinharti* are more elongate and have about 10 less ribs.

*Distribution*: This species is known to occur from the Gulf of California to Panama. In some localities it is fairly abundant in 10 to 35 fathoms, especially off Manzanillo, Mexico, and off Port Parker, Costa Rica.

#### *Arca (Anadara) similis* C. B. Adams.

Plate I, Figures 2 and 5.

*Arca similis* C. B. Adams, *Ann. Lyceum Nat. Hist. New York*, Vol. 5, 1852, p. 485 (separate p. 261). "Panama."

*Type Locality*: Panama.

*Range*: Corinto, Nicaragua, to Panama.

*Collecting Stations*: Nicaragua: Corinto (200-D-19), 12-13 fathoms, mangrove leaves on bottom; Costa Rica: Port Culebra; Puntarenas Lagoon.

*Description*: The shell of *Arca similis* was described by Adams as having 40 to 44 ribs. The specimens which we identify as this species have about 40 ribs. They differ from *Arca tuberculosa* Sowerby in that Adams's species is not as high in proportion to the length, the umbonal ridges are rounded and the dorsal margin is rounded at each end.

The species *Arca tuberculosa* and *A. similis* occur together and they are quite similar in general features but they appear to be separable at least in adult forms. Carpenter considered *A. similis* to be "scarcely a variety of *A. tuberculosa*."

*Distribution*: The present record of this species from Corinto, Nicaragua, is an extension northward of the range. It is also known to occur off Costa Rica and Panama.

#### *Arca (Anadara) tuberculosa* Sowerby.

*Arca tuberculosa* Sowerby, *Proc. Zool. Soc. London*, May 17, 1833, p. 19. "Hab. ad Real Llejos." "Found at low water at the roots of the mangrove trees." — Reeve, *Conch. Icon.*, Vol. 2, *Arca*, 1844, species 18, pl. 3, fig. 18. Original locality record cited.

*Type Locality*: Real Llejos [near Corinto], Nicaragua, at low water at the roots of mangrove trees.

*Range*: Ballenas Lagoon, Lower California, and the Gulf of California, to Tumbes, Peru.

*Collecting Stations*: Costa Rica: Port Culebra; Culebra Bay; Ballena Bay; Golfo Bay; 1 mile south of Golfo Bay; Panama: Isla Partida; Colombia: Gorgona Island.

*Description*: Shell large, elongately ovate, moderately inflated, moderately thick, and ornamented by about 33 to 37 ribs which are tuberculate toward the margin and especially so anteriorly. The dorsal margin of the shell is usually somewhat angulated at either end.

<sup>2</sup> *Barbatia (Diluvarca) halidonata oresta* Woodring, *Carnegie Inst. Washington. Publ.* 366, May, 1925, p. 43, pl. 4, figs. 5 and 6. Bowden, Jamaica, Miocene.

<sup>3</sup> *Anadara (Anadara) springvalensis* Vokes, *Amer. Mus. Novitat.*, No. 988, May 16, 1938, p. 10, fig. 3. Springvale, Trinidad. Upper Miocene.

<sup>4</sup> *Anadara secticostata* Reeve, Tomlin, *Jour. Conch.*, Vol. 18, No. 7, May, 1928, p. 189. "Coiba, valves dredged in 10-12f." See *Arca secticostata* Reeve, *Conch. Icon.*, Vol. 2, *Arca*, February, 1844, sp. 38, pl. 6, fig. 38. "Hab. — ?"



Compared to *Arca similis* C. B. Adams, *A. tuberculosa* is higher in proportion to the length, more angulated at the ends of the dorsal margin, and the posterior umbonal area is more angular.

This species is commonly used for food along the west coast of Central America. At La Union, El Salvador, these shells are known as "coriles" and in Nicaragua as "tuchia." It is the "concha prieta" of Peruvian fishermen.

**Distribution:** This species occurs commonly from the Gulf of California to Peru. It often occurs abundantly in soft mud of mangrove swamps. It has been cited as occurring in archaeologic ruins and kitchen middens of southwestern United States.

#### Subgenus *Arcopsis* von Koenen.

##### *Arca (Arcopsis) solida* Sowerby.

*Byssarca solida* Sowerby, *Proc. Zool. Soc. London*, May 17, 1833, p. 18. "Hab. ad Paytam, Peruviae." "Found under stones."

*Arca solida* Sowerby, Reeve, *Conch. Icon.*, Vol. 2, *Arca*, 1844, species 106, pl. 16, fig. 106. Original locality record cited.

**Type Locality:** Païta, Peru, under stones.

**Range:** Asuncion Island. Lower California, Mexico, and the Gulf of California, to Païta, Peru, and the Galápagos Islands.

**Collecting Stations:** Nicaragua: Corinto (200-D-19), 12-13 fathoms, mangrove leaves on bottom; Costa Rica: Port Parker (203-D-3), 12 fathoms, shelly mud.

**Description:** Shell small, somewhat inflated, subquadrate, with many fine radial ribs. It may be distinguished from other similar shells by the character of the ligament which is restricted to a small triangular pit beneath the beaks and by the lack of teeth in the central part of the hinge.

*Arca solida* is very similar to *A. afra* Gmelin, an African species. Lamy considered the two forms to be only subspecifically different.

Maury has mentioned a similarity between *A. solida* and *A. adamsi* (Shuttleworth) Smith from the upper Miocene and Pliocene of Trinidad, and Recent from North Carolina to Brazil.

**Distribution:** *Arca solida* occurs commonly from the Gulf of California to Peru, under rocks between tides.

#### Subgenus *Lunarca* Gray.

##### *Arca (Lunarca) vespertina* Mörch.

Plate I, Figures 6 and 7.

*Arca (Argina) vespertina* Mörch, *Malakozool. Blätter*, Bd. 7, 1861, p. 204. "Realejo in Cribrina obtecta valv. sinistra fracta, an juvenilis?." — Kobelt, Martini-Chemnitz *Conchyl.-Cab.*, Bd. 8, Abt. 2, *Arca*, 1891, p. 225. Original record cited.

**Type Locality:** Realejo [near Corinto], Nicaragua.

**Range:** Mazatlan, Sinaloa, Mexico, to Corinto, Nicaragua.

**Collecting Station:** Nicaragua: Corinto (200-D-17, 19), 7-13 fathoms, sand, mangrove leaves.

**Description:** "T. alba quadrangularis postice lata, fere perpendiculariter recte truncata, angulo inferiore rotundato; margo dorsalis rectus, ventralis antice leviter adscendens; costis circiter 38 approximatis, unde margine interno profunde sulcato; umbonis coerulescentibus, radiis obscuris tribus quorum posticis subconfluentibus. Long. 7 3/4, alt. 6 1/4 mill." (Original description).

Mörch compared *Arca vespertina* to *Arca obliqua* Reeve, a species from West Africa which it somewhat resembles in shape.

The shell described by Mörch was apparently a juvenile specimen. Specimens studied by us from Corinto, Nicaragua, and from off Mazatlan, Mexico, seem to be referable to *Arca vespertina*. Small specimens agree closely with Mörch's description. Large specimens are much more elongate in proportion to the height of the shell. There are from 36 to 38 ribs which are medially sulcated toward the ventral margin. The color of the shell is white with a black spot on the beak and the shell is covered by a dark brown periostracum.

*Arca brevifrons bucaruana* Maury & Sheldon is very similar but is more quadrate in shape, thicker, and with about 33-35 ribs.

The three forms, *Arca brevifrons*, *A. brevifrons bucaruana* and *A. vespertina*, appear to be closely related, differing in the number of ribs. The Peruvian form *brevifrons* possesses 22-23 ribs, *bucaruana* from Panama with 33-35 ribs, and *vespertina* from Central America and Mexico with 36-38 ribs. The species described as *Arca (Barbatia?) melanoderma* by Pilsbry & Lowe appears to be referable to *Arca brevifrons bucaruana*.

**Distribution:** This rare species has been found only occasionally from Mazatlan, Mexico, to Corinto, Nicaragua.

#### Subgenus *Barbatia* Gray.

##### *Arca (Barbatia) reeveana* d'Orbigny.

*Arca helbingii* Bruguière, Reeve, *Conch. Icon.*, Vol. 2, *Arca*, April, 1844, species 90, pl. 14, fig. 90. "Hab. St. Elena and Monte Christi, West Columbia, and island of Corrigidor, Philippines (found under stones at low water); Cuming."

*Arca reeveana* d'Orbigny, *Voy. Amér. Mérid.*, Vol. 5, 1846, p. 635. "a été rencontrée à Payta (Pérou) par M. Fontaine, et à Monte-Cristi (république de l'Equateur), par M. Cuming." [Not the record Corrigidor, Philippine Islands]. New name for *Arca*.



*helbingii* Bruguière, Reeve, 1844, pl. 14, fig. 90, not *Arca helbingii* Bruguière, 1792.

**Type Locality:** Santa Elena, Ecuador, here designated as type locality. Monte Cristi, Ecuador, also cited originally.

**Range:** Manuela Lagoon, Lower California, and Punta Penasco, Sonora, Mexico, to Zorritos, Peru.

**Collecting Stations:** Mexico: Santa Inez Bay, Gulf of California; Arena Bank, Gulf of California (136-D-4), 55 fathoms, mud; Costa Rica: Ballena Bay.

**Description:** Shell large, variable in shape, attaining a length of 65 mm., oblong, often very sinuate at the ventral margin, moderately thin for the group, beaks often nearly central; sculpture of radiating threads crossed by concentric lines which, where they cross the radials, cause beading, especially on the center of the valves, ribs usually coarser along the posterior dorsal margin; hinge arcuate, with the central teeth fine and closely-set, the distal teeth are larger, longer, and oblique; ligament occupying the entire cardinal area; diamond-shaped grooves on the area are closely set.

The sculpture of *Arca reeveana* is in its general features similar to that of *Arca candida* Gmelin of the Caribbean region, and *Arca velata* Sowerby and *A. decussata* from the Indo-Pacific region. *Arca platensis* Philippi from the Tertiary of Patagonia is a related species as is *A. subhelbingi* d'Orbigny from the Miocene of France.

**Distribution:** This species occurs commonly from the Gulf of California to Peru, and is found attached to the under surfaces of rocks at low tide.

### Subgenus *Calloarca* Gray.

#### *Arca (Calloarca) alternata* Sowerby.

*Byssarca alternata* Sowerby, *Proc. Zool. Soc. London*, May 17, 1833, p. 17. "Hab. in Columbia occidentali." "Found attached to stones, on a rocky bottom, in twelve fathoms."

*Arca alternata* Sowerby, Reeve, *Conch. Icon.*, Vol. 2, *Arca*, 1844, species 88, pl. 13, fig. 88. Original locality record cited.

**Type Locality:** Western Colombia, in 12 fathoms, on rocky bottom.

**Range:** Punta Penasco, Sonora, Mexico, to Ecuador.

**Collecting Stations:** Mexico: Santa Inez Bay, Gulf of California (145-D-1, 3, and shore), 4-13 fathoms, sand; Nicaragua; Costa Rica: Port Parker (203-D-1, 3), 12-15 fathoms, sandy mud, crushed shell, shelly mud.

**Description:** Shell thin, elongate, somewhat contracted medially and with a sharply carinated posterior umbonal slope. It is ornamented by 26 to 28 ribs and those posterior to the carinated portion, the three on the anterior end of the shell are coarse

and crenulated. On the medial portion of the shell the ribs are flat, smooth, close-set and divided down the middle by a fine incised line. The cardinal area is long and narrow, and wider in front of the beaks. The ligament occupies only the posterior part of the area.

**Distribution:** This is not a common species but is known to occur from the Gulf of California to Ecuador. It is also known to occur in the Pleistocene of Magdalena Bay, Lower California.

### Subgenus *Cara* Gray.

#### *Arca (Cara) emarginata* Sowerby.

*Arca emarginata* Sowerby, *Proc. Zool. Soc. London*, May 17, 1833, p. 20. "Hab. ad littora Maris Pacifici." "From Atacamas, Real Llejos, Xipixapi, Panama, and the Gulf of California."—Reeve, *Conch. Icon.*, Vol. 2, *Arca*, 1844, species 26, pl. 4, fig. 26. Original locality records cited.

**Type Locality:** Atacamas, Ecuador, here designated as type locality. Pacific Ocean littoral, Xipixapi, Ecuador, Panama, and the Gulf of California, also cited originally.

**Range:** Gulf of California, to Guayaquil, Ecuador.

**Collecting Station:** Nicaragua: Corinto (200-D-11, 19), 8-13 fathoms, mangrove leaves on bottom.

**Description:** Shell thin, elongate, anterior end very short, posterior end produced and with a distinct notch just below the hinge line in the upper posterior margin; the color is white with usually a black ray on the sulcated beaks; ribs 28 to 30, flat and closely-set, divided by very narrow interspaces; anterior ribs more or less medially grooved and crenulate, the ribs over the umbonal ridge are wider; cardinal area long, narrow, and somewhat wider anteriorly; teeth very fine on the center of the hinge but longer and larger distally, especially toward the posterior end. The shell attains a length of at least 50 mm.

This species is somewhat similar to *Arca esperanza* Maury from the Miocene of Trinidad.

**Distribution:** This species is found occasionally from the Gulf of California to Ecuador. It is also known to occur in the Pleistocene of Magdalena Bay, Lower California.

### Subgenus *Cunearca* Gray.

#### KEY TO THE SPECIES OF *Cunearca*.

- A. Shell with 30 or more ribs
  - a. Shell thin, posteriorly produced  
aequatorialis
  - aa. Shell thick, only slightly posteriorly  
produced ..... bifrons
- B. Shell with less than 30 ribs



- a. Cardinal area with chevron-shaped grooves; 26-28 ribs.....*esmeralda*
- aa. Cardinal area without chevron-shaped grooves
- b. Beaks and apex of area central, 28 ribs.....*perlabiata*
- bb. Beaks and apex of area anterior, about 22-23 ribs.....*nux*

***Arca (Cunearca) aequatorialis* d'Orbigny.**

*Arca ovata* Reeve, Conch. Icon., Vol. 2, *Arca*, February, 1844, species 49, pl. 8, fig. 49. "Hab. St. Elena, South America (found in sandy mud at the depth of from six to eight fathoms); Cuming."

*Arca aequatorialis* d'Orbigny, Voy. Amér. Mérid., Vol. 5, 1846, p. 636. Santa Elena, Ecuador. New name for *Arca ovata* Reeve, not *Arca ovata* Gmelin, 1791.

**Type Locality:** Santa Elena, Ecuador, in 6 to 8 fathoms, sandy mud.

**Range:** Mazatlan, Mexico, to Zorritos, Peru, and the Galápagos Islands.

**Collecting Stations:** Guatemala: 7 miles west of Champerico (197-D-1-2), 14 fathoms, mud; El Salvador: La Libertad (198-D-1-2), 13-14 fathoms, mud; Nicaragua: Corinto (200-D-10, 19), 7-13 fathoms, mangrove leaves on bottom; Panama: Gulf of Chiriqui (221-D-1-5), 35-40 fathoms, sandy mud.

**Description:** The shell of this interesting species is moderately thin and inequivalved. The color is white but often stained with reddish-brown. The ribs are about 30 to 32 in number, those on the left valve are broader than those on the right. The ribs on the anterior area are coarsely nodose, those on the posterior area are flat, smooth, and less prominent.

*Arca aequatorialis* differs from *A. bifrons* Carpenter, in the smaller, thinner shell which is more produced posteriorly and ornamented with more coarsely nodose ribs anteriorly.

**Distribution:** This species is known to occur from Mazatlan, Mexico, to Peru. Specimens dredged by the *Zaca* Expeditions were taken in depths from 7 to 40 fathoms.

***Arca (Cunearca) bifrons* Carpenter.**

*Arca brasiliiana* Lamarck, Reeve, Conch. Icon., Vol. 2, *Arca*, 1844, species 17, pl. 3, fig. 17. "San Blas, Bay of California (found on the sands); Cuming." [Not the record "Rio Janeiro, coast of Brazil"].

*Arca bifrons* Carpenter, Cat. Mazatlan Shells, February, 1856, p. 134. "Mazatlan," Mexico.

*Arca (Cunearca) bifrons* Carpenter, Maury, Palaeontogr. Amer., Vol. 1, No. 4, 1922, p. 197 (35), pl. 31 (3), fig. 12. Near the mouth of Rio Chepo, Panama.

**Type Locality:** Mazatlan, Mexico.

**Range:** Gulf of California, to Paita, Peru.

**Collecting Station:** Costa Rica: Gulf of Dulce.

**Description:** Shell with about 30 rather broad ribs on the left valve, the anterior ones transversely wrinkled, not nodulose, the posterior ones flat, subobsolete and separated only by very narrow interspaces.

A single left valve referred to *Arca bifrons* is present in the collection from the Gulf of Dulce, Costa Rica. It agrees with Reeve's figure (pl. 3, fig. 17) and with that given by Maury (pl. 31 (3), fig. 12). We are inclined to question the reference to Sowerby's figure (Gen. Shells, pl. 217, fig. 3) of *A. inaequilateralis* to *A. bifrons*. Apparently the name *bifrons* proposed by Carpenter has priority over the name *cordata* of Deshayes which was proposed for *A. cardiiformis* Sowerby, 1833, not *A. cardiiformis* Basterot, 1825.

The shell of *Arca bifrons* is larger and thicker than that of *A. aequatorialis*. It also differs from *Arca aequatorialis* in that the posterior end is less produced and the shell slopes more steeply from the posterior umbonal ridge.

***Arca (Cunearca) esmeralda* Pilsbry & Olsson.**

*Arca (Cunearca) esmeralda* Pilsbry & Olsson, Proc. Acad. Nat. Sci. Philadelphia, Vol. 93, September 9, 1941, p. 53, pl. 13, figs. 4 and 5. "Canoa formation, Punta Blanca," Ecuador, Pliocene.

**Type Locality:** Punta Blanca, Ecuador, Canoa formation, Pliocene.

**Range:** Isabel Island, Mexico, to Panama.

**Collecting Station:** Panama: Gulf of Chiriqui (221-D-1-5), 30-40 fathoms, sandy mud.

**Description:** Shell fairly large and moderately thick; valves ornamented by 26 to 28 ribs, those on the left valve strongly nodose, and on the right valve the anterior 8 or 10 are strongly nodose and the remainder are weakly nodose or smooth; a low wide depressed area extends from the beaks to the posterior ventral margin, most noticeable on large specimens; beaks strongly prosogyrate; the apex of the ligamental area is situated about a third of the length from the anterior end; the area is ornamented by 2 to 4 chevron-shaped grooves; hinge with a row of teeth which are a little larger at the ends than in the middle, there are about 18 to 20 teeth in the anterior series and 32 to 34 in the posterior series; the margins of the valves are fluted. The dimensions of the type specimen were given as: length, 57 mm., height, 53 mm., semi-diameter, 25.5 mm.

The shell of *Arca esmeralda* differs from those of the other West American species of *Cunearca* in that it possesses chevron-



shaped grooves on the ligamental area. Small shells of *Arca esmeralda* differ from those of *Arca nux* in that they have chevron-shaped grooves on the ligamental area which is less sloping, in the more numerous ribs, 26 to 28 rather than 22 to 23, the posterior dorsal area is more inflated and less steeply sloping and lacks the strong posterior umbonal angulation, and the posterior margin is more rounded. *Arca esmeralda* attains a much greater size than does *A. nux*.

Specimens dredged off Mexico and Panama agree so closely with the description and illustrations of *Arca esmeralda*, which was described from the Pliocene of Ecuador, that we have referred them to that species.

**Distribution:** This species occurs from off Isabel Island, Mexico, to Panama. It is also known to occur in the Pliocene of Ecuador.

#### *Arca (Cunearca) nux* Sowerby.

*Arca nux* Sowerby, *Proc. Zool. Soc. London*, May 17, 1833, p. 19. "Hab. ad Xipixapi." "Found in sandy mud at a depth of twelve fathoms."—Reeve, *Conch. Icon.*, Vol. 2, *Arca*, 1844, species 1, pl. 1, fig. 1. Original locality record cited.

**Type Locality:** Xipixapi, Ecuador, in 12 fathoms, sandy mud.

**Range:** Concepcion Bay, Lower California, to Zorritos, Peru.

**Collecting Stations:** Mexico: Santa Inez Bay, Gulf of California (145-D-1 to 3), 4-13 fathoms, sand; Banderas Bay; Tenacatita Bay; Guatemala: 7 miles west of Champerico (197-D-1-2), 14 fathoms, mud; El Salvador: La Libertad (198-D-1-2), 13-14 fathoms; Meanguera Island, Gulf of Fonseca, 16 fathoms, sand, mud; Nicaragua: Corinto (200-D-10-11, 19), 7-13 fathoms, mangrove leaves, sand; Costa Rica: Port Parker (203-D-1, 3), 12-15 fathoms, sandy mud, crushed shell, shelly mud; Port Culebra (206-D-1-2-3), 14 fathoms, sandy mud; Golfito, Gulf of Dulce; Panama: Gulf of Chiriqui (221-D-1-5), 35-40 fathoms, sandy mud.

**Description:** Shell small, oblique, gibbous, ornamented by about 22 to 23 ribs. Specimens of this species are usually not over 15 to 20 mm. in altitude and the ribs are often noded although sometimes only slightly so. The beaks are situated anteriorly about two-thirds to three-fourths the length of the hinge line and the ligamental area is asymmetrical.

In *Arca perlabiata* the beaks are nearly central and the ligamentary area is symmetrical. *Arca chemnitzii* Philippi from the Caribbean region is similar to *A. nux*, but has a thicker shell, steeper posterior slope and broader ligamentary area.

**Distribution:** This species occurs in fairly shallow water from the Gulf of California to Peru.

#### *Arca (Cunearca) perlabiata* Grant & Gale.

*Arca labiata* Sowerby, *Proc. Zool. Soc. London*, May 17, 1833, p. 21. "Hab. ad Real Llejos et ad Tumbes." "Dredged among sandy mud at a depth of seven fathoms." Coll. Cumming.—Reeve, *Conch. Icon.*, Vol. 2, *Arca*, 1844, species 7, pl. 1, fig. 7. Original locality record cited.

*Scapharca (Cunearca) labiata* Sowerby, Maury, *Palaeontogr. Amer.*, Vol. 1, No. 4, 1922, p. 199 (37), pl. 29 (1), fig. 8. Peru.

*Arca (Arca) perlabiata* Grant & Gale, *Mem. San Diego Soc. Nat. Hist.*, Vol. 1, 1931, p. 141. Earlier records cited. New name for *Arca labiata* Sowerby, not *Arca labiata* Sowerby.

**Type Locality:** Real Llejos [near Corinto], Nicaragua, here designated. Tumbes, Peru, also cited originally.

**Range:** Magdalena Bay, Lower California, and the Gulf of California, to Tumbes, Peru.

**Collecting Stations:** Mexico: Arena Bank, Gulf of California (136-D-2), 45 fathoms, *Arca* conglomerates; Tangola-Tangola (196-D-17), 23 fathoms, mud; Nicaragua: Corinto; Isla Cardon; Costa Rica: Port Parker (D-1, 3), 12-15 fathoms, sandy mud, crushed shell, shelly mud; Ballena Bay, Gulf of Nicoya (213-D-11 to 17), 35 fathoms, mud.

**Description:** Shell heart-shaped, high and fairly thick. There are about 28 ribs which are transversely lightly nodulous. It bears considerable resemblance to *Arca nux* but can be separated by the heavier and much less oblique and larger shell, more numerous ribs, and in that the beak is nearly central in relation to the symmetrically diamond-shaped ligamentary area, while in *A. nux* the beaks are anterior and the area is asymmetrical.

*Arca chemnitzii* Philippi from the Caribbean has a smaller, less symmetrical ligamentary area and the beaks are anterior to the center of the shell rather than almost central as in *A. perlabiata*.

*Arca cacica* Olsson from the Miocene of Costa Rica is said to bear some resemblance to *A. nux*.

**Distribution:** This species occurs from Magdalena Bay, Lower California, and the Gulf of California, to Peru. It has been taken on sand bars at extreme low tide and has been dredged in rather shallow water. It is also known to occur in the Pleistocene of southern California and Lower California.

#### Subgenus *Larkinia* Reinhart.

##### KEY TO THE SPECIES OF *Larkinia*.

- A. About 25 to 27 radial ribs.....*grandis*
- B. About 31 to 38 radial ribs.....*multicostata*

#### *Arca (Larkinia) grandis* Broderip & Sowerby.

*Arca grandis* Broderip & Sowerby, *Zool. Jour.*, Vol. 4, January, 1829, p. 365. "Hab."



—Reeve, Conch. Icon., Vol. 2, *Arca*, December, 1843, species 4, pl. 1, fig. 4. "Hab. Real Llejos, Bay of Guayaquil, etc., western coast of South America; Cuming, Hinds."

*Type Locality*: Original locality not known. Panama Bay here designated as type locality.

*Range*: Magdalena Bay, Lower California, and the Gulf of California, to Tumbes, Peru.

*Collecting Stations*: Nicaragua: Potosi and Monypenny Point; Castanones Peninsula, Corinto; Isla Encantada, Corinto; Costa Rica: Port Parker; Ballena Bay; Jasper Island; Golfito Bay; Panama: Bahia Honda.

*Description*: This is a large, very thick, squarish *Arca* which occurs commonly at Panama and other Central American localities and is used for food. These big shells are very thick and may weigh as much as two and one-half pounds. They are ornamented by about 25 to 27 radial ribs which may be slightly nodulous anteriorly.

The closest relatives of this species occur in the Miocene of the Caribbean region where a number of names have been applied to various forms such as *Arca patricia* Sowerby, *Arca usiacurii* Anderson, *Arca patriarcha* Anderson, *Arca patricia waringi* Maury, *Arca grandis colombiensis* Weisbord, and *Arca grandis cedralensis* Weisbord.

*Distribution*: This species occurs from Lower California to Peru. It is often taken at extreme low tide on sand bars.

#### *Arca (Larkinia) multicostata* Sowerby.

*Arca multicostata* Sowerby, *Proc. Zool. Soc. London*, May 17, 1833, p. 21. "Hab. ad oras Americae Centralis." "Dredged from a depth of twelve fathoms in the Gulf of Tehuantepec."—Reeve, Conch. Icon., Vol. 2, *Arca*, 1844, species 23, pl. 4, fig. 23. Original locality record cited.

*Type Locality*: Gulf of Tehuantepec, Mexico, in 12 fathoms.

*Range*: Newport Bay, California, to Panama, and the Galápagos Islands.

*Collecting Stations*: Mexico: Santa Inez Bay, Gulf of California (141-D-1 to 4, and shore), 7-10 fathoms, sand, sandy mud, crushed shell, weed; Santa Inez Bay (145, shore); Santa Inez Bay, Monument Station; Ceralbo Island, Gulf of California; Arena Point, Lower California; Gorda Banks, Gulf of California (150-D-6), 60 fathoms, muddy sand, rocks; Chamela Bay; Tenacatita Bay; Port Guatulco; Tangola-Tangola (196-D-8), 9 fathoms, sand; Costa Rica: Port Parker; Culebra Bay.

*Description*: *Arca multicostata* Sowerby somewhat resembles *A. grandis* Broderip & Sowerby but is easily separated by the presence of about 31 to 36 ribs rather than about 25 to 27 in *A. grandis* which species

has a much heavier shell. *Arca (Anadara) reinharti* Lowe is somewhat similar to small shells of *Arca multicostata* but it has only about 25 to 27 radiating ribs and is a much more oblique shell. Both *Arca reinharti* and young specimens of *A. multicostata* are slightly inequivalved, the left valve overlapping the right.

*Distribution*: This species occurs from southern California to Panama and the Galápagos Islands. In tropical waters it is occasionally taken on sand bars at very low tide and may be dredged in shallow waters.

#### Subgenus *Scapharca* Gray.

##### KEY TO THE SPECIES OF *Scapharca*.

- A. Shell with 39 or more ribs.....*obesa*
- B. Shell with about 30 to 32 ribs
  - a. Shell elongate, anterior ribs grooved.....*concinna*
  - aa. Shell squarely ovate, anterior ribs not grooved.....*cepooides*

#### *Arca (Scapharca) cepoides* Reeve.

*Arca cepoides* Reeve, Conch. Icon., Vol. 2, March, 1844, species 66, plate 10, fig. 66. "Hab. San Miguel, South America (found in sandy mud); Cuming."

*Type Locality*: San Miguel, Panama, in sandy mud.

*Range*: Ceralbo Island, Gulf of California, to San Miguel, Panama.

*Collecting Station*: Mexico: Ceralbo Channel, Gulf of California (137-D-3), 46 fathoms, rock.

*Description*: Shell rather large, subquadrate, ventricose, ornamented by about 32 smooth flat-topped ribs. The specimens obtained in the present collection are small, less than 15 mm. in length.

*Distribution*: This species is rather rarely taken but is known to occur from the Gulf of California to Panama.

#### *Arca (Scapharca) concinna* Sowerby.

*Arca concinna* Sowerby, *Proc. Zool. Soc. London*, May 17, 1833, p. 20. "Hab. in America Centrali." "Found in coarse sand, at a depth of twelve fathoms, in the Gulf of Nocoioy."—Reeve, Conch. Icon., Vol. 2, *Arca*, 1844, species 34, pl. 6, fig. 34. Original locality record cited.

*Type Locality*: Gulf of Nicoya, Costa Rica, in 12 fathoms, coarse sand.

*Range*: Santa Inez Bay, Lower California, to Panama.

*Collecting Stations*: Mexico: Santa Inez Bay, Gulf of California (143-D-4-5), 18-25 fathoms, sand; Arena Bank, Gulf of California (136-D-2), 45 fathoms, mud, *Arca* conglomerates; 4 miles south-southwest of Maldonado Point (192-D-1,-3), 26-38 fathoms, mud; Tangola-Tangola Bay (196-D-1,-18-19-20), 5-50 fathoms, gray sand, mud;



Costa Rica: Cedro Island, Gulf of Nicoya (213-D-1, 10), 10 fathoms, mud; off Ballena Bay, Gulf of Nicoya (213-D-11, 17), 35 fathoms, mud; Panama: Gulf of Chiriqui (221-D-1-5), 35-40 fathoms, sandy mud.

*Description:* Shell elongate, and ornamented by about 30 rather fine ribs, of which the most anterior ones are divided by a medial groove.

This shell resembles in general characters *A. inaequilateralis* Guppy from the Miocene of the Caribbean region.

*Distribution:* This species is known to occur at various localities from the Gulf of California to Panama. Most of the specimens dredged by the *Zaca* Expeditions were from depths of 18 to 50 fathoms.

#### *Arca (Scapharca) obesa* Sowerby.

*Arca obesa* Sowerby, *Proc. Zool. Soc. London*, May 17, 1833, p. 21. "Hab. in Columbia Occidentali." "A few specimens only were dredged, in seven fathoms, at Atacamas."—Reeve, *Conch. Icon.*, Vol. 2, *Arca*, 1843, species 3, pl. 1, fig. 3. Original locality cited.

*Type Locality:* Atacamas, Ecuador, in 7 fathoms.

*Range:* Off San Jose del Cabo, Lower California, Mexico, to Negritos, Peru.

*Collecting Stations:* Mexico: Tangola-Tangola (196-D-17), 23 fathoms, mud; Guatemala: 7 miles west of Champerico (197-D-1-2), 14 fathoms, mud; El Salvador: La Libertad (198-D-1-2), 13-14 fathoms, mud; Nicaragua: Corinto (200-D-19), 12-13 fathoms, mangrove leaves on bottom; Costa Rica: 14 miles southeast of Judas Point (214-D-4), 61 fathoms, mud, rocks; Panama: Gulf of Chiriqui (221-D-1-5), 35-40 fathoms, sandy mud.

*Description:* The ventricose ovate form and large number of fine, close-set ribs are characteristic of *Arca obesa*. The species usually has about 42 to 44 ribs but some specimens from La Libertad, El Salvador, have only 39.

*Distribution:* This species occurs from Lower California to Peru but is not a common species. The specimens from the *Zaca* Expeditions were dredged from depths of 12 to 61 fathoms.

#### GENUS *Noetia* GRAY.

##### Subgenus *Noetia* s.s.

#### *Noetia (Noetia) reversa* Gray in Sowerby.

*Arca reversa* Gray (MS) in Sowerby, *Proc. Zool. Soc. London*, May 17, 1833, p. 20. "Hab. in Peruvia." "Found in soft mud, at a depth of seven fathoms, at Tumbes."—Reeve, *Conch. Icon.*, Vol. 2, *Arca*, 1843, species 5, pl. 1, fig. 5. Original locality record cited.

*Type Locality:* Tumbes, Peru, in 7 fathoms, soft mud.

*Range:* Gulf of California, to Peru.

*Collecting Stations:* Guatemala: 7 miles west of Champerico (197-D-1-2), 14 fathoms, mud; El Salvador: La Libertad (198-D-1-2), 13-14 fathoms, mud; Nicaragua: Corinto (200-D-19), 12-13 fathoms, mangrove leaves on bottom; Isla Cardon, Corinto; Costa Rica: Golfito, Gulf of Dulce; Panama: Gulf of Chiriqui (221-D-1-5), 35-40 fathoms, sandy mud.

*Description:* Shell of medium size, sub-trigonal, inflated, equivalve, ornamented by about 36 ribs. Anterior end rounded, posterior end sloping and subtruncated. Beaks large, prominent, posterior, and curved toward the posterior of the shell.

*Distribution:* This species occurs at various localities from the Gulf of California to Peru. Specimens collected by the *Zaca* Expeditions were dredged at depths of 12 to 40 fathoms.

#### Subgenus *Sheldonella* Maury.

#### *Noetia (Sheldonella) delgada* Lowe.

*Arca delgada* Lowe, *Trans. San Diego Soc. Nat. Hist.*, Vol. 8, No. 6, March 21, 1935, p. 16, pl. 1, fig. 2. "Manzanillo, 20 fathoms."—MacNeil, *U.S. Geol. Surv., Prof. Paper* 189-A, 1938, p. 39. Original record cited.

*Type Locality:* Manzanillo, Mexico, 20 fathoms.

*Range:* Manzanillo, Mexico.

*Collecting Station:* Mexico: Manzanillo (184-D-2), 30 fathoms, gravelly sand.

*Description:* Shell ornamented by about 30 ribs. The rounded posterior portion of the shell is expanded and very obliquely produced.

MacNeil has suggested the possibility that *Arca delgada* may be related to *Noetia (Eontia) centrota* Guppy which has been reported from the upper Miocene and Pliocene of Trinidad. However, the general shape of *delgada* appears to be closer to that of *Noetia (Sheldonella) maoica* Maury from the Miocene of the Dominican Republic.

*Distribution:* This species is known only from the type locality, Manzanillo, Mexico, where it has been dredged in 20 to 30 fathoms.

#### Subgenus *Eontia* MacNeil.

#### *Noetia (Eontia) olssoni* Sheldon & Maury.

*Noetia olssoni* Sheldon & Maury, *Palaeontogr. Amer.*, Vol. 1, No. 4, 1922, p. 172 (10), pl. 29 (1), figs. 6, 9 (as *Arca (Noetia) olssoni* on expl. to plate). "Bucaru," Los Santos Province, Panama.

*Eontia olssoni* Sheldon & Maury, MacNeil, *U. S. Geol. Surv., Prof. Paper* 189-A, 1938, p. 13, pl. 1, figs. 19, 20. Earlier records cited.

*Type Locality:* Bucaru, port of Tonosi, Los Santos Province, Panama.



**Range:** Corinto, Nicaragua, to Negritos, Peru.

**Collecting Station:** Nicaragua: Corinto (200-D-10, 11, 19), 7-13 fathoms, mangrove leaves, sand.

**Description:** The shell of *Noetia* (*Eontia*) *olssoni* is easily recognized from that of other west American species of *Noetia* by the narrow, elongate shell in which the posterior end is not transversely expanded but bears a medial depression.

*Noetia olssoni* is similar to *N. centrota* Guppy from the upper Miocene and Pliocene of Trinidad, and *N. bisulcata* Lamarck, Recent in the Caribbean and Atlantic coast of South America from Colombia to Uruguay. The west American species differs in the greater length posteriorly, more central beaks and nearly equal rows of teeth and in other details. The largest specimen in the present collection measures 14.6 mm. in length.

**Distribution:** The occurrence of this species at Corinto, Nicaragua, furnishes an extension northward in its range. It occurs south to Peru. It is also known to occur in the Pleistocene of Magdalena Bay, Lower California.

#### Superfamily Ptericeae.

#### Family Pteriidae.

#### KEY TO THE GENERA OF THE PTERIIDAE.

- A. Hinge extended posteriorly forming a wing ..... *Pteria*
- B. Hinge not extended posteriorly to form a wing ..... *Pinctada*

#### GENUS *Pteria* SCOPOLI.

#### *Pteria sterna* Gould.

*Avicula sterna* Gould, *Proc. Boston Soc. Nat. Hist.*, Vol. 4, November, 1851, p. 93. "Inhabits Mazatlan."—Gould, *Boston Jour. Nat. Hist.*, Vol. 6, 1853, p. 404, pl. 16, fig. 7. "Inhabits Mazatlan? Lieut. Green. Panama. Prof. Adams, Col. Jewett."

*Avicula peruviana* Reeve, *Conch. Icon.*, Vol. 10, *Avicula*, March, 1857, species 53, pl. 14, fig. 53. "Hab. Peru."

**Type Locality:** Mazatlan, Mexico.

**Range:** Hueneme Point, California, to the Gulf of California, and south to Paita, Peru.

**Collecting Stations:** Mexico: Cedros Island, in channel (126-D-19), 25 fathoms, rocks, algae; Santa Inez Bay: Arena Bank; Cape San Lucas, Lower California.

**Description:** Shell oblique and with a posterior wing and shorter anterior ear beneath which is a byssal notch. Rows of spines occur on unworn shells. On worn shells yellowish stripes usually are present on a brown background.

The degree of development of a posterior wing, thickness of shell, and obliquity of

the hinge line appear to be variable characters in *Pteria sterna*. Some specimens have a well developed posterior wing while in others this is only slightly developed. In some specimens it can be observed that a long wing was present in the young stage but later the sinus on the posterior margin became more rounded and thus produced only a small wing. Some specimens possess thicker shells of a dark color which are ornamented by fine radial color bands. This appears to be an inconstant character as shown by some specimens on which the earlier part of the shell is dark and the later part is ornamented by yellowish stripes. Odhner pointed out that the width of color bands of *Pteria* (*Electrotoma*) *zebra* Reeve depends upon the situs to which it is attached.

From a consideration of the characters shown in a series of specimens it appears that there is no satisfactory basis for separating *Pteria peruviana* Reeve from *P. sterna* Gould.

**Distribution:** This species occurs at various localities from southern California to Peru. It is only occasionally found in southern California, but it occurs rather abundantly at certain localities in the Gulf of California. It does not occur in the great numbers originally found in the Gulf of California due to pearl fishing. This species is said to have produced literally bushels of pearls.

#### GENUS *Pinctada* BOLTEN.

#### *Pinctada mazatlanica* Hanley.

*Meleagrina mazatlanica* Hanley, *Cat. Rec. Bivalve Shells*, Ap., 1856, p. 388, pl. 24, fig. 40. "Mazatlan."

*Avicula barbata* Reeve, *Conch. Icon.*, Vol. 10, *Avicula*, March, 1857, species 9, pl. 5, fig. 9. "Hab. Panama (under stones at low water); Cuming."

**Type Locality:** Mazatlan, Mexico.

**Range:** Gulf of California, to Paita, Peru, and the Galápagos Islands.

**Collecting Stations:** Mexico: Santa Inez Bay, near Concepcion Point, Lower California; Banderas Bay; Chamela Bay; Passavera Island, Chamela Bay (shore); Port Guatulco (195-D-15, also shore), 1.5 fathoms, coral bottom; Tangola-Tangola Bay; Nicaragua: Isla Cardon, Corinto; Costa Rica: Port Parker; Potrero Grande; Culebra Bay; Golfito, Gulf of Dulce; Piedra Blanca; Colombia: Gorgona Island.

**Description:** This is the "concha de perla" or "Panama shell," the common commercial pearl oyster of the Gulf of California and Panama. The color of the exterior of the shell of *Pinctada mazatlanica* is grayish-yellow or light brown. On unworn specimens there are radial rows of pointed foliaceous spines and often radial rows of



spots a little darker than the ground-color. The nacre is silvery white with a narrow golden or brassy colored margin.

This species is closely related to *Pinctada margaritifera* Linnaeus, one of the well known pearl oysters of the Indo-Pacific region. Jameson believed that there is intergradation between the two species. He also mentioned that in the group related to *P. margaritifera*, the lightest colored forms, *mazatlanica*, *zanzibarensis*, *persica* and *erythraensis*, occur on the shores of the great continents, the Australian and Malay shells are intermediate in color, and the oceanic variety *cumingii* is darkest in color.

Compared to *Pinctada margaritifera* and others of the group, *P. mazatlanica* is characterized by its greater convexity, greater anterior projection, and light brown color. Jameson pointed out that the anterior margin below the byssal notch projects farther forward than in any other related form. A perpendicular to the anterior end of the hinge would cut off about one-third of the valve. The posterior angle of *mazatlanica* is acute or but rarely a right angle. The posterior margin of the nacre slopes forward from the hinge, resembling in this character *P. maxima* Jameson described from New Guinea.

**Distribution:** This species occurs from the Gulf of California to Peru. It is fairly abundant at various localities in the Gulf of California and Panama where it is fished for pearls. It was formerly very abundant in the Gulf of California but the beds have been greatly depleted due to pearl fishing.

#### Family Pinnidae.

##### KEY TO THE GENERA OF THE PINNIDAE.

- A. Shell triangular; a median groove interiorly dividing the nacreous layer into two parts.....*Pinna*
- B. Shell ham-shaped; no median groove interiorly.....*Atrina*

#### GENUS *Pinna* LINNAEUS.

##### *Pinna rugosa* Sowerby.

*Pinna rugosa* Sowerby, *Proc. Zool. Soc. London*, September 25, 1835, p. 84. "Hab. in Sinu Panamensi. (Isle of Rey)." "They were procured from sand banks."—Reeve, *Conch. Icon.*, Vol. 11, *Pinna*, 1858, species 50, pl. 26, fig. 50. Original locality cited.

**Type Locality:** Isle of Rey, Bay of Panama, sand banks.

**Range:** Manuela Lagoon, Lower California, and Punta Penasco, Sonora, Mexico, to Panama.

**Collecting Stations:** Mexico: Gorda Banks, Gulf of California (150-D-7), rock, calcareous algae; Acapulco; Nicaragua: Corinto (200-D-1-3), 2—6.5 fathoms, man-

grove leaves; Castanones Peninsular Lagoon, Corinto; Costa Rica: Long Beach N. W. of Port Parker; Golfito Bay; Gulf of Dulce.

**Description:** This species possesses an elongate, triangular, rugose shell. It grows to a length of a foot and a half or more and is ornamented by about eight rows of foliaceous, tubular spines. The spines may be almost obsolete on old specimens.

**Distribution:** This species occurs rather commonly along the west coast of Mexico and south to Panama.

#### GENUS *Atrina* GRAY.

##### KEY TO THE SPECIES OF *Atrina*.

- A. Shell ornamented by 26-38 rows of spines
  - a. About 38 rows of spines; ventral margin broadly rounded.....*oldroydii*
  - aa. About 26 rows of spines; ventral margin slightly rounded.....*texta*
- B. Shell ornamented by about 18 rows of strong, regular, tubular spines.....*maura*

##### *Atrina maura* Sowerby.

*Pinna maura* Sowerby, *Proc. Zool. Soc. London*, September 25, 1835, p. 84. "Hab. apud Panamam." Obtained "from muddy banks."—Reeve, *Conch. Icon.*, Vol. 11, *Pinna*, 1858, species 54, pl. 29, fig. 54. Original locality cited.

**Type Locality:** Panama, muddy banks.

**Range:** Santo Domingo (in kitchen middens), and Magdalena Bay, Lower California, and Punta Penasco, Sonora, Mexico, to Peru.

**Collecting Stations:** Mexico: Gulf of California, Santa Inez Bay, near Point Concepcion along shore of Lower California, also at Monument Station; Banderas Bay; Nicaragua: Monypenny Point, Gulf of Fonseca, 4 fathoms, mud; Corinto (200-D-1-10), 1/2 to 7 fathoms, mangrove leaves.

**Description:** The shell of this species has a nearly straight dorsal margin. About 18 rows of fairly strong, unusually regular, yellowish-white arched tubular spines occur on a brown or rusty black background; these spines almost disappear on the anterior side. Some specimens are of a yellowish or dark greenish-olive color.

According to Pilsbry and Lowe the shells of *Atrina maura* are known as "hachas" or hatchets by the native fishermen along western Mexico. The large white muscle which is used for food is said to resemble and taste much like that of the giant scallop of the Atlantic Coast.

Winckworth indicated that "*Pinna*" *tuberculosa* Sowerby is identical with "*Pinna*" *maura* Sowerby. However, the descriptions of Sowerby and Hanley and the figures given by Reeve seem to indicate that *tuber-*



*culosa* is a distinct species and that *Pinna lanceolata* Sowerby, a preoccupied name, can be placed in the synonymy of *maura*. The shell of *Atrina tuberculosa* Sowerby is triangular, inflated, and quite different in general appearance from that of *A. maura*.

*Atrina rigida* Dillwyn from the Antillean region bears a resemblance to *A. maura*.

***Atrina oldroydii* Dall.**

*Atrina oldroydii* Dall, *Nautilus*, Vol. 14, No. 12, April, 1901, p. 143. "Taken alive by fishermen in 25 fathoms, San Pedro Bay," California.—Dall, *U. S. Nat. Mus., Bull.* 112, 1921, p. 17, pl. 2, figs. 4, 5, 6. Off San Pedro, California, in 25 fathoms.

*Type Locality*: San Pedro Bay, California, in 25 fathoms.

*Range*: San Pedro, California, to Cedros Island, and Magdalena Bay, Lower California.

*Collecting Station*: Mexico: east of Cedros Island, in Channel (126-D-17), 40 fathoms, mud.

*Description*: The shell of this large dark colored *Atrina* from southern California and Lower California is much wider than that of *Atrina texta* n. sp. and the posterior end is more oblique and less square in outline than is that of *A. maura*. There are about 38 radiating ribs which bear rather fine low spines which do not extend over the ventral surface and on the posterior fourth of the shell the ribs and spines are obsolete. The specimens in the present collection are broken but the largest one measures 240 mm. from beak to base.

*Atrina serrata* Sowerby from the Atlantic coast is a similar species.

*Distribution*: This species is not commonly found but is known to occur in the waters off southern California and along the west coast of Lower California, south to Magdalena Bay.

***Atrina texta* Hertlein, Hanna & Strong, sp. nov.**

Plate I, Figures 9 and 10.

Shell roughly triangular with a curved beak; dorsal side gently convex, the ventral concave behind the beak then gently convex, straightening out to the posterior margin which is gently rounded; shell translucent, showing the external sculpture on the interior; color pale horn brown, darker on the beaks and on a large irregular blotch over the muscle scar; posterior margins gaping about 10 mm. and ventral margin gaping about 5 mm. in the concave portion behind the beaks; exterior sculpture consisting of about 26 radial rows of short and low triangular spines, slightly recurved; these spines are also regularly arranged in rows concentric with the growth lines; this zone of sculpture completely crosses the

ventral margin but the rows become fewer anteriorly as the zone crosses the umbonal ridge; ventral zone marked only by rather coarse growth lines except posteriorly where the radial rows of spines gradually fade away. Length, 141 mm.; width, 80 mm.; convexity, 35 mm.

Holotype in Calif. Acad. Sci. Paleo. Type Coll., from Sta. 150-D-4, Gorda Bank area off the southern end of Lower California, Lat. 23°01' N., Long. 109°30' W.; dredged in 70 fathoms; collected by the Templeton Crocker-Beebe Expedition, April 21, 1936.

This interesting species has been compared with all the other west coast forms of *Atrina* and in none of them is there found the combination of characters shown here. *Atrina oldroydii* Dall is perhaps the closest; that species also has radial and concentric rows of fine spines but the shape is decidedly asymmetrical, the beaks are not hooked and the dorsal margin is scarcely convex. The shell of the new species differs from that of *Atrina maura* Sowerby in the wider, squarer posterior end and in that it is ornamented by about 26 radial rows of triangular spines rather than about 18 rows of regular, semitubular spines.

**Family Pedalionidae.**

**GENUS *Pedalion* SOLANDER IN HUDESFORD.**

***Pedalion chemnitzianum* d'Orbigny.**

Plate I, Figure 8.

*Perna chemnitziana* d'Orbigny, in Sagra, *Moll. Cuba*, Vol. 2, 1845, p. 346. "Nous l'avons reçue de Cuba, de la Martinique et de Sainte-Croix; elle vit attachée aux rochers par son byssus au niveau des basses marées ordinaires." Reference to *Concha semiaurita* Chemnitz (not *Ostrea semiaurita* Linnaeus), *Neues Syst. Conchyl.-Cab.*, Vol. 7, p. 250, Tab. 59, fig. 580. West Indies.

*Type Locality*: Cuba, here designated. Martinique and St. Croix also cited originally.

*Range*: Coronado Islands, off the west coast of northern Lower California, Mexico, to Chile. Also Atlantic.

*Collecting Stations*: Mexico: Sulphur Bay, Clarion Island; Port Guatulco (195-D-14), 4 fathoms, coral; also on shore; Tangola-Tangola, on beach; Nicaragua: Fumarole Island; Potosi and Monypenny Point; Costa Rica: Piedra Blanca.

*Description*: The shell of *Pedalion chemnitzianum* is very variable. It may be quadrate, elongate, or irregular in shape and it may be fairly thick or thin. It is sometimes ornamented by fine radial ornamentation but usually this is lacking and the exterior shows only scaly concentric layers. The color may be yellowish-brown but often it is partially and occasionally almost wholly, of a purple color. There are usually about 6



to 8 and occasionally as many as 12 ligamental pits along the hinge line. Right valve with a byssal sinus.

There appears to be no satisfactory method of separating the west American forms here referred to *Pedalion chemnitzianum* from the east American species of this name. Many workers familiar with the Atlantic species have been unable to detect any constant differences between the forms occurring on the east and west coast. *Pedalion janus* Carpenter, a species occurring commonly from San Ignacio Lagoon, Lower California, and the Gulf of California to Oaxaca, Mexico, usually possesses a thinner shell ornamented by radial sculpture, and it

apparently has a more northern distribution; at least it has not been observed by us in collections from Panamic waters. However some specimens seem to show the characters of both *P. chemnitzianum* and *P. janus*, as pointed out by Stearns. No doubt the two forms are closely related. Carpenter believed that variants of *P. chemnitzianum* approach the Hawaiian species *P. incisum* Conrad, while those of *P. janus* approach *P. costellatum* Conrad.

*Distribution:* This species occurs commonly attached to rocks or other objects between tides or in shallow water from northern Lower California to Chile, and also Florida and the Caribbean region.



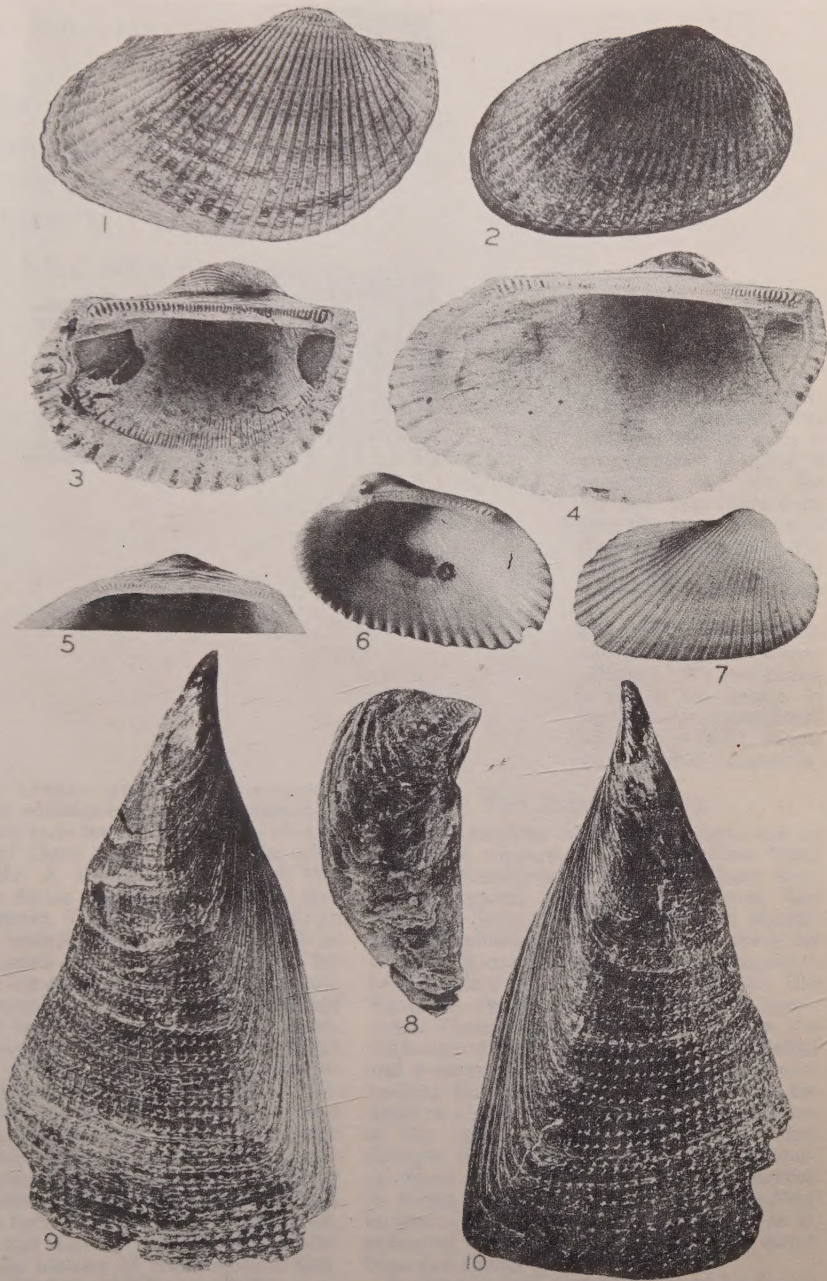
## EXPLANATION OF THE PLATE.

## PLATE I.

- Fig. 1. *Arca (Anadara) mazatlanica* Hertlein & Strong, sp. nov. Holotype, right valve, from Station 153-D-2, dredged in 120 fathoms (218 meters), Lat. 23°06'00" N., Long. 106°47'00" W., 19 miles west of Mazatlan, Sinaloa, Mexico. Length, 62 mm., height, 36.3 mm., convexity (one valve), 15.5 mm. P. 156.
- Fig. 2. *Arca (Anadara) similis* C. B. Adams. Hypotype, right valve, from Puntarenas Lagoon, Costa Rica. Length, 50 mm., height, 31.8 mm., convexity (one valve), 15 mm. P. 157.
- Fig. 3. *Arca (Anadara) biangulata* Sowerby. Hypotype, left valve, from Station 143-D-5, dredged in 18 fathoms (33 meters), Lat. 26°54'00" N., Long. 111°53'00" W., Santa Inez Bay, Lower California. Length, 49 mm., height, 36 mm., convexity (one valve), 17 mm. P. 155.
- Fig. 4. *Arca (Anadara) mazatlanica* Hertlein & Strong, sp. nov. Holotype. View of the interior of the left valve of the specimen shown in Fig. 1.
- Fig. 5. *Arca (Anadara) similis* C. B. Adams. View of the interior showing hinge of the left valve of the specimen shown in Fig. 2.
- Fig. 6. *Arca (Lunarca) vespertina* Mörch. Hypotype, right valve, from Loc. 27230 (C.A.S.), Petatlan Bay, about 6 miles south of Sihuatenejo, Guerrero, Mexico. View of the interior. Length, 36.1 mm., height, 22.5 mm., convexity (one valve), 9.1 mm. P. 158.
- Fig. 7. *Arca (Lunarca) vespertina* Mörch. View of the exterior of the specimen shown in Fig. 6.  
The shell of this species becomes more elongate in large specimens such as this one, but juvenile forms are more quadrate in shape.
- Fig. 8. *Pedalion chemnitzianum* d'Orbigny. Hypotype, right valve, from Loc. 28186 (C.A.S.), Kino Bay, Sonora, Mexico. Length, 20.5 mm., height, 46.5 mm., convexity (both valves), 8 mm. P. 166.
- Fig. 9. *Atrina texta* Hertlein, Hanna & Strong, sp. nov. Holotype, right valve, from Station 150-D-4, Gorda Banks off the southern end of Lower California, Lat. 23°01'00" N., Long. 109°29'00" W., dredged in 70 fathoms (128 meters). Length, 141 mm., width, 80 mm., convexity (both valves), 35 mm. P. 166.
- Fig. 10. *Atrina texta* Hertlein, Hanna & Strong, sp. nov. Left valve of the specimen shown in Fig. 9.

All the specimens illustrated on this plate are in the type collection of the Department of Paleontology of the California Academy of Sciences.





MOLLUSKS FROM THE WEST COAST OF MEXICO AND CENTRAL AMERICA.



